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(54) Modular refrigerator.

(57) A refrigerator comprising a body unit (1) having a refrigeration compartment (12), a refrigeration unit (3) removably connected to the body unit and having a refrigeration circuit in which a condenser, an evaporated and a motor-compressor are arranged. In the refrigeration unit (3) a fan is arranged for circulating air from the evaporator to the refrigeration compartment (12) and backwards. For conveying the air the body unit (1) is provided with ducts (18, 23).

In order to meet the user's requirements with respect to the extent of the refrigeration capacity the refrigerator can be extended with at least one further body unit (30) which is connectable to the first mentioned body unit (1) in a removable way, corresponding ends of the ducts (18-31, 23-32) being interconnectable. In this way a modular construction is obtained.

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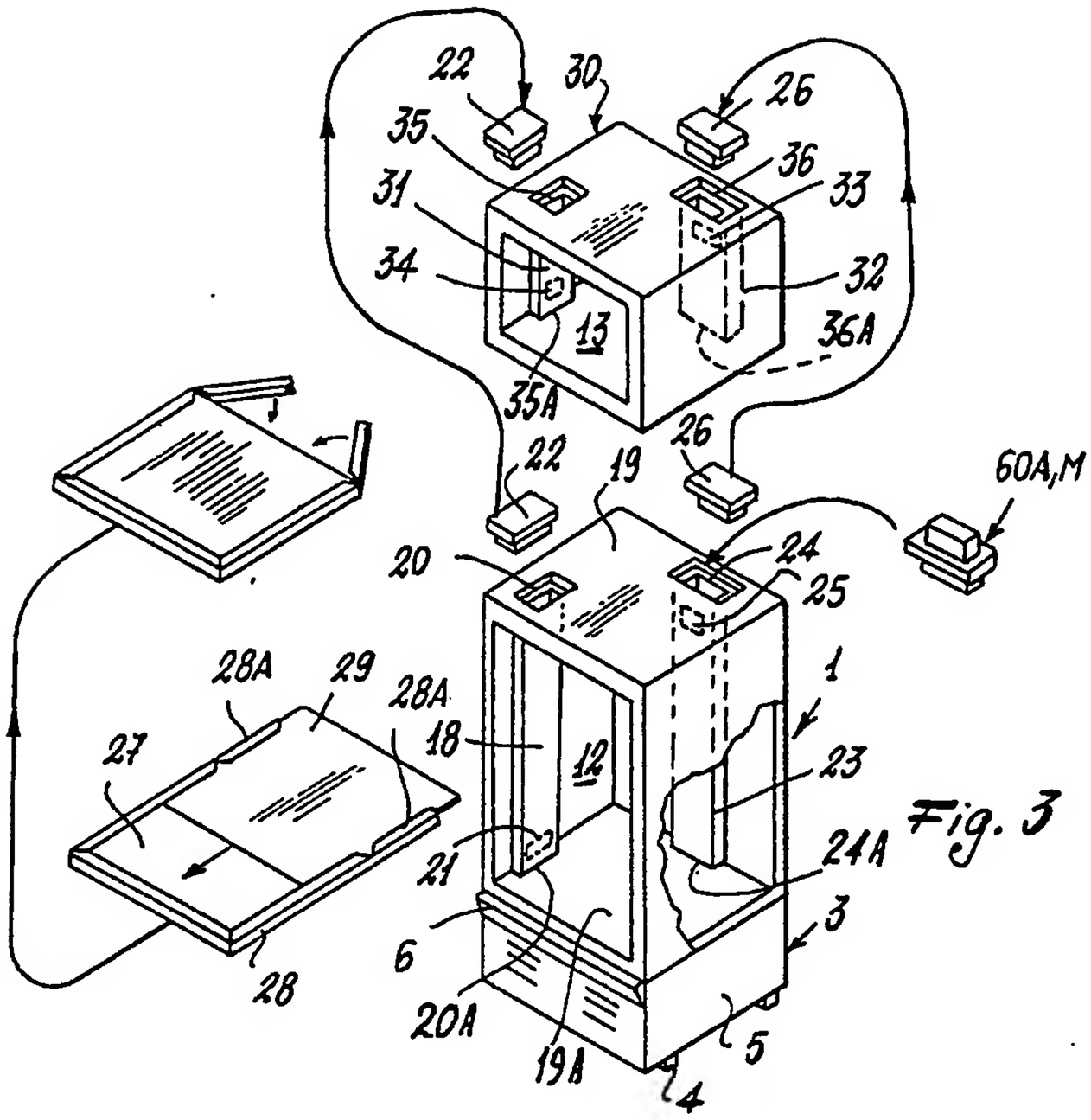

22
30
26
35
36
31
33
34
32
13
36A
35A
26
22
19
60A,M
20
24
25
1
28A
29
28A
18
12
27
23
21
24A
3
6
20A
19A
5
4
28

Fig. 3

Modular refrigerator.

A refrigerator comprising a body unit defining a refrigeration compartment, a refrigeration unit removably connected to the body unit and defining a condenser, an evaporator and a motor-compressor, a fan arranged in the refrigeration unit for circulating air from the evaporator to the refrigeration compartment and backwards, and ducts arranged in the refrigeration unit and in the body unit for conveying air produced by said fan, said ducts in the body unit having apertures opening into the refrigeration compartment.

Refrigerators of this type are known. USA patents 3,116,615 and 3,126,717 describe a refrigerator of the forced air circulation type in which in the lower part of its body or cabinet there is provided a seat which removably supports a refrigeration unit formed from a compressor, a condenser associated with a fan which cools it, and and evaporator associated with a fan which generates a cold air circulation through the preservation compartment or compartments by way of ducts present in the body. When repair is required, the refrigeration unit can be removed from the body seat in which it is located and if necessary replaced by a working unit to thus substantially reduce the time for which the refrigerator remains inactive.

The known refrigerator does not however enable other body units to be added to the existing ones in order to adapt the refrigerator capacity to expanding requirements of the user. The object of the present invention is therefore to extend the referigeration capacity in order to meet the user's requirements even after their purchase, and if necessary by the user himself.

According to the invention the refrigerator can be extended with at least one further body unit similar to the first mentioned body unit and connectable to either the first mentioned body unit or the refrigeration unit in a removable way, each duct having open ends at both sides terminating in a top wall and a bottom wall corresponding ends of the ducts being interconnectable. In this way a kind of modular construction is obtained.

A further advantage is that such a modular refrigerator is easier to transport and store by virtue of the separation of its parts.

A further advantage is that the maintenance is simpler and faster by merely replacing the faulty refrigeration unit by an operational one.

Another industrially benefit is that the refrigeration unit design can be always the same and only the formation of the body units can be varied, these body units being of lesser cost and of simpler design and construction than the refrigeration units. The refrigeration unit can then be manufactured in a specialised department or factory and the other refrigerator parts be manufactured elsewhere. The costs currently encountered in destroying defective or damaged refrigerators are considerably reduced.

The invention will now be described with reference to the accompanying drawing in which:

Figure 1 is a perspective schematic view of a refrigerator according to the invention;

Figure 2 is a perspective view of a further refrigerator;

Figure 3 is a perspective exploded view, with parts removed, showing how the refrigerator of Figure 1 can be converted to that of Figure 2 by adding a further body unit;

Figure 4 is a diagrammatic section through the refrigeration unit on the line IV-IV of Figure 5;

Figure 5 is a diagrammatic section on the line V-V of Figure 4;

Figure 6 is a diagrammatic section on he line VI-VI of Figure 5;

Figure 7 is a diagrammatic sectional view of a refrigeration unit with a double cooling air inlet and outlet;

Figure 8 is a diagrammatic partial section on the line VIII-VIII of Figure 7.

In Figures 1 to 3, the reference numeral 1 indicates the parallelepiped body unit of a refrigerator indicated overall by A and known commercially as a table top refrigerator, i.e. a refrigerator of height such that its upper cover plate 2 can be used for supporting objects by being of kitchen table height. The body unit 1 rests and is removably fixed, for example by screws and centering pins, on a base 3 which is provided with adjustable and removable support feet 4 and has a contour substantially coinciding with the body unit contour.

The base, which forms the refrigeration unit, has a box housing 5 which comprises a front step 6 to allow lower hinging of a conventional door 7. The refrigeration unit 3 incorporates (see Figures 4, 5 and 6) a hermetically sealed compressor unit 8 including an electric motor, a condenser bank 9 associated with an axial fan 10 for cooling the bank and an evaporator bank 10′ associated with a centrifugal fan 11 which circulates cold air through the preservation compartment 12. The evaporator bank 10′ and its fan 11 are located in a chamber 14 of the refrigeration unit 3 which is insulated and upperly closed by an insulated cover 15. The chamber 14 is connected to an inlet duct 16 to which the air returns after circulating through the compartment 12. It is also connected to a delivery duct 17 which feeds cold air to this compartment.

The connection is made by connection elements 60A, 60M which are provided with through holes and which, as can be seen in Figure 4, are inserted partly into the body unit 1 and partly into the base 3 so that the lower face of the body unit 1 adheres against the upper face of the base. For the connection between the base (refrigeration unit) 3 and the body unit 1, the connection elements 60A, 60M, can be integral with the base cover 15. The projecting part of the intake connector 60A is inserted (see Figure 4) into a correspondingly shaped open end 20A provided in a bottom wall 19A of the body unit 1 and forming the outlet of an intake duct 28 which extends over the entire height of the body unit 1 to open into open end 20 provided in its top wall 19. In the lower part of the duct 18 there is provided a side aperture 21, if necessary controllable by a manually or automatically controlled valve, thermostatic valve or the like (not shown) able to control, e.g. as far as its closure, the passage cross-section of this aperture.

The open end 20 can be closed by a plug 22 when the required refrigerator is that shown in Figure 1, whereas the plug is removed if the required refrigerator is that shown in Figure 2, as will be clarified hereinafter.

Likewise, the projecting part of the delivery connection element 60M is inserted (see Figure 4) into an open end 24A provided in the bottom wall 19A of the body unit 1 and forming the inlet of a delivery duct 23 which extends over the entire height of the body unit 1 to open into an open end 24 provided in its top wall 19. In the upper part of this duct there is provided a side aperture 25, if necessary controllable by a manually or automatically controlled valve, thermostatic valve or the like (not shown) able to control, e.g. as far as its closure, the passage cross-section of this aperture. The open end 24 can also be closed by a plug 26 when the required refrigerator is that shown in Figure 1, whereas the plug is removed if the required refrigerator is that shown in Figure 2, as will be clarified hereinafter.

The refrigerator of Figure 1 is completed by the removable cover plate 2 which as can be seen in Figure 3 consists of an insulating panel 27, a surrounding channel section 28, for example of metal or plastics, and a-cover sheet 29 formed for example from laminated plastic, which is inserted into the duct section above the panel 27 and locked by screws after bending together the channel sections 28A of the duct section 28. The top plate 2 is fixed on the top wall 19 by screws, which pass through the insulating panel 27 and have their heads covered by the sheet 29.

When the refrigerator of Figure 1 is to be converted into the refrigerator of Figure 2, a second body unit 30 is placed on top of body unit 1. Body unit 30 is similar to body unit 1 and comprises a preservation compartment 13. This second body unit 30 comprises two ducts 31, 32 open at their upper and lower ends and positioned in such a manner that they coincide with the ducts (18, 23) of the underlying body unit 1. The delivery duct 32, in a like manner to the duct 23, comprises an upper side aperture 33 opening into the compartment 13. This aperture can also be controlled manually or automatically by a valve member, thermostatic valve or the like (not shown). The intake duct 31, in a similar manner to the duct 18, comprises a lower side aperture 34 opening into the compartment 13. This can also be controlled manually or automatically by a valve member or thermostatic valve, not shown. The connection between said ducts is made by connection elements such as the already described elements 60A, 60M, and are inserted in a like manner.

To convert the refrigerator of Figure 1 into the refrigerator of Figure 2, the cover plate 2 and plugs 22, 26 are removed. The connection elements 60A, 60M are inserted into the upper open ends 20, 24 of the ducts 18, 23. The body unit 30 is then placed on top of the body unit 1 whereby the connection elements 60A, 60M enter into the open ends 35A, 36A of the ducts 31, 32 and is fixed to the underlying body unit 1 for example by screws and centering pins. The plugs 22, 26 are placed in the upper open ends 35, 36 of the ducts 31, 32 and the cover plate 2 is finally mounted on the body unit 30. The doors 7, 7A for each of the body units 1 and 30 are mounted by conventional methods at the most appropriate stage.

For the required electrical connections, projecting or embedded electrical contacts 70 can be provided (see Figure 6) on the rear sides of the refrigeration unit 3 and body units 1 and 30, and are connected together by a removable connector 71 enclosed in an insulating cover 72. Male and female electrical connections can also be used, and in this case will be provided on the contacting faces of the body units and base. These connections can be used for powering lamps, warning lamps and the like, probes, actuators (for valves), switches, fan cut-outs, resistance elements, anti-condensate means, optical display units and similar devices provided in the refrigerator compartments.

If the refrigerator of Figure 2 is to be constructed directly without passing via the refrigerator of Figure 1, this is done by fixing the lower body unit 1, upper body unit 30 and refrigeration unit 3 together, closing the upper openings of the intake and delivery ducts and fitting the top surface to complete the construction.

It is apparent that the position of the body units 1 and 30 can be reversed, i.e. the body unit 30, with the body unit 1 thereon, can be in contact with

the refrigeration unit 3.

The cover plate 2 may incorporate the refrigerator control devices, such as the temperature, rapid freezing and possibly timer controls, together with warning lamps indicating the state of operation of the refrigerator. The necessary electrical connections to the refrigeration unit can be made as described heretofore.

The invention also includes embodiments in which the refrigeration unit 3 is not used as the base but instead lies on a body unit or is interposed between two body units. In this latter case, in the refrigeration unit (see Figures 7 and 8) indicated by 3A in these Figures, the intake duct 16A is a through duct which again communicates with chamber 14A housing the evaporator 10'A. The delivery duct is divided into two parts 17A, 17B (Figure 8) extending in opposite directions an thus opening on opposite sides of the refrigeration unit. Air produced by the centrifugal fan 11A is conveyed into both duct parts.

It is apparent that the term "duct" also includes channels extending within the walls of the body units 1, 30.

The use of the removable refrigeration unit 3 results in series of advantages. On the one hand it results in a production saving in that the same unit can be used for refrigerators of different capacities and different numbers of compartments. It also enables the user to purchase a small refrigerator which can then be enlarged to meet expanding requirements. It also enables refrigerator construction to be standardised (by using the same unit) in the case both of free-standing refrigerators and of those built into kitchen furniture. Finally, it allows any required servicing to be carried out easily and rapidly on the refrigerator.

Claims

1. A refrigerator comprising a body unit (1) defining a refrigeration compartment (12), a refrigeration unit (3) removably connected to the body unit and defining a condenser (9), an evaporator and a motor-compressor (8), a fan (11) arranged in the refrigeration unit for circulating air from the evaporator to the refrigeration compartment and backwards, and ducts (16, 17, 18, 23) arranged in the refrigeration unit and in the body unit for conveying air produced by said fan, said ducts in the body unit (1) having apertures (21, 25) opening into the refrigeration compartment, characterized in that, the refrigerator can be extended with at least one further body unit (30) similar to the first mentioned body unit (1) and connectable to either the first mentioned body unit or to the refrigeration unit (3) in a removable way, each duct (18, 23, 31, 32) having open ends (20, 20A, 24, 24A, 35, 35A, 36, 36A) at both sides terminating in a top wall (19) and a bottom wall (19A), corresponding ends of the ducts being interconnectable.

2. A refrigerator as claimed in Claim 1, characterized in that corresponding ducts (18-31, 23-32) are connectable by means of connector elements (60A, 60M).

3. A refrigerator as claimed in Claim 1, characterized in that removable plugs (22, 26) are provided for closing one end (20, 20A, ..., 36A) of the ducts (18, 23, 31, 32).

4. A refrigerator as claimed in one of the preceding Claims, in that the top wall (19) of the upper body unit comprises a separate cover pate (2).

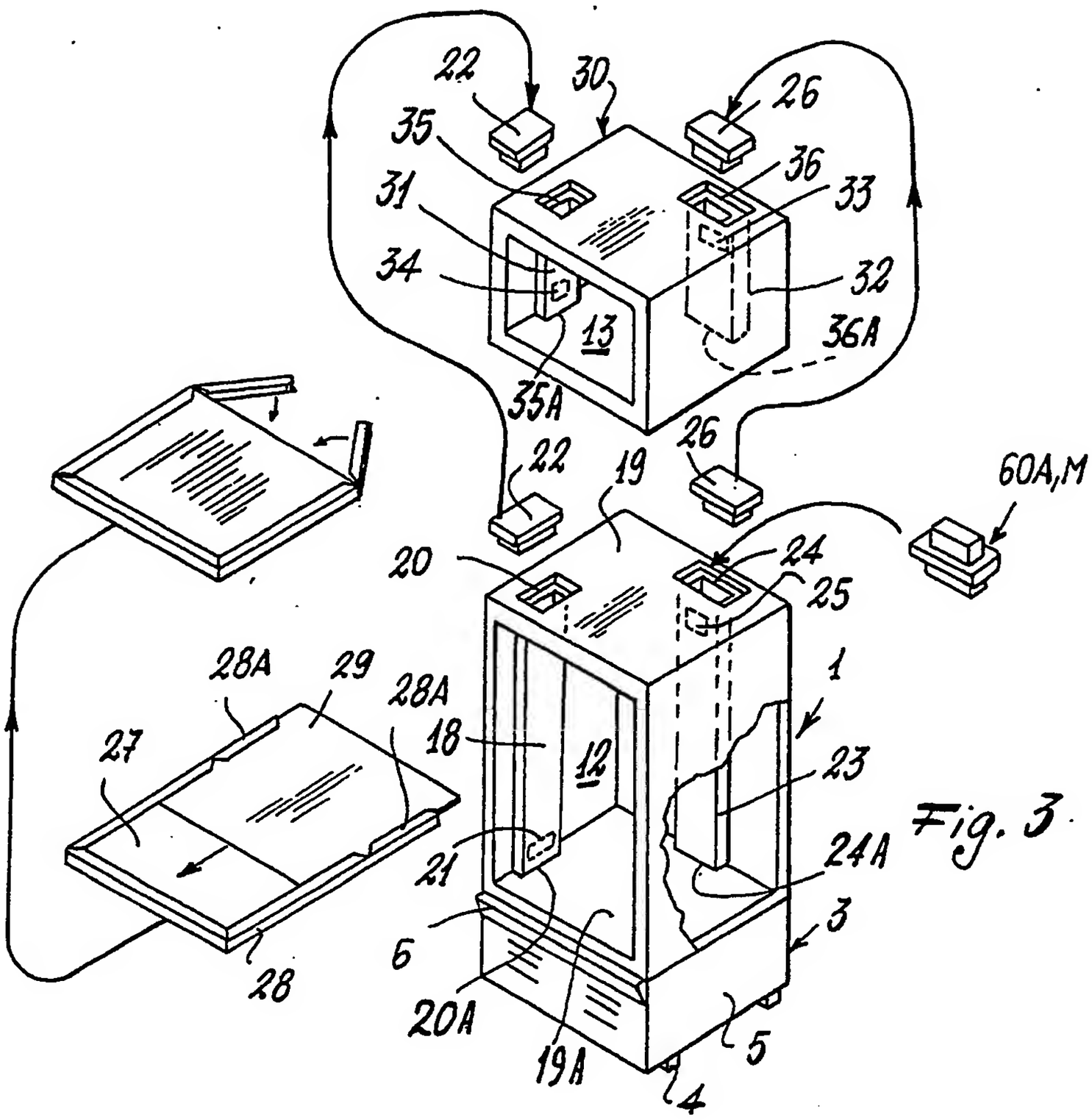


Fig. 3

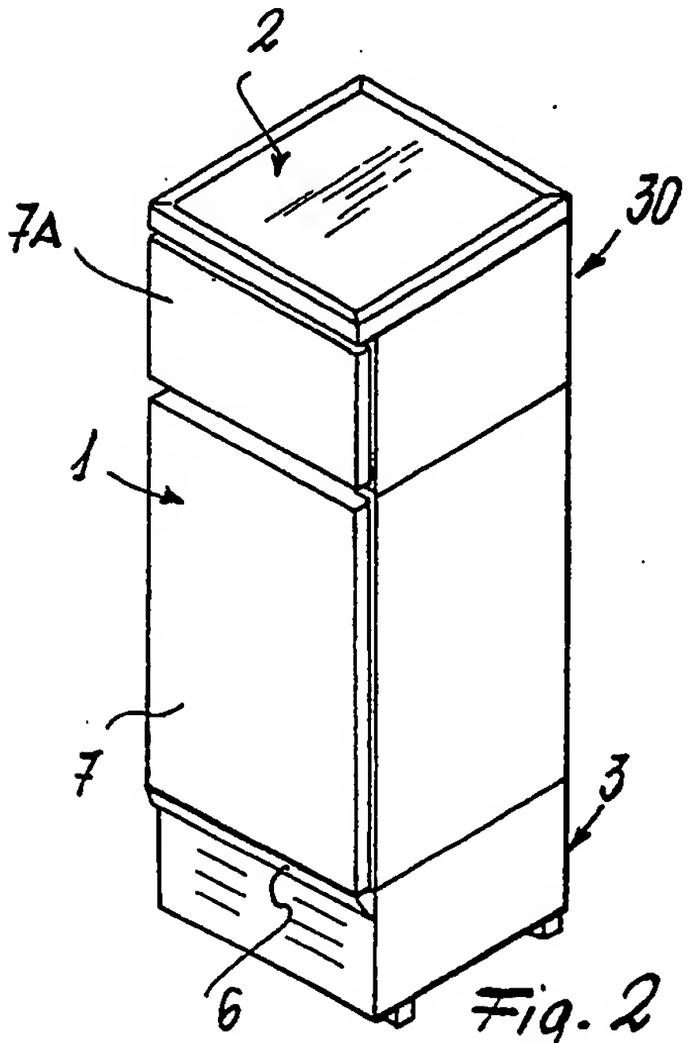


Fig. 2

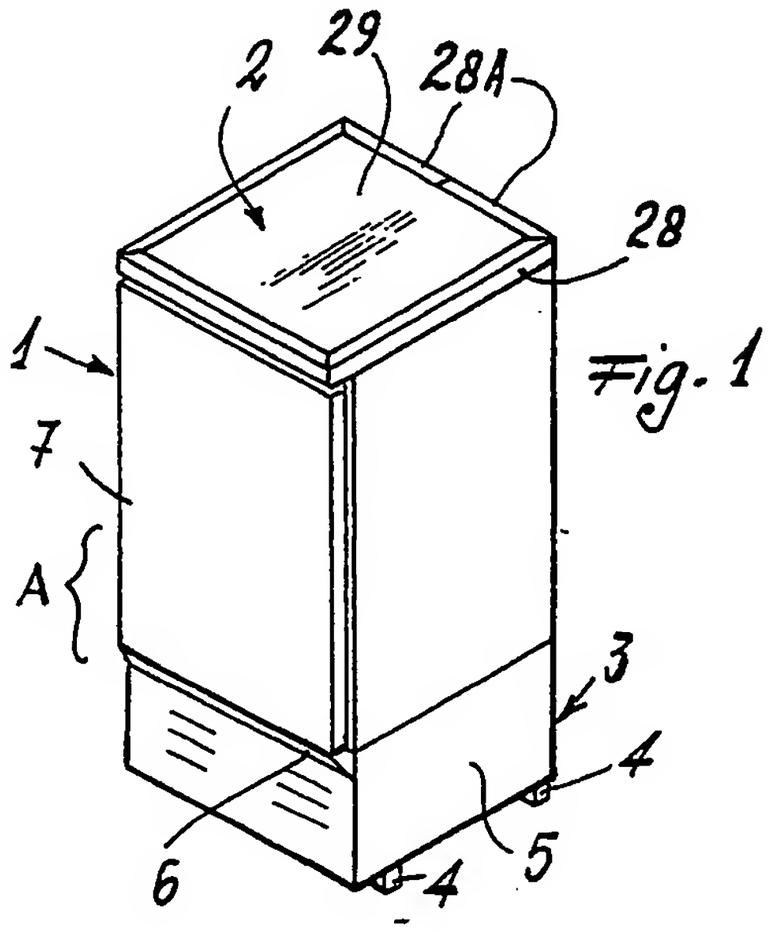


Fig. 1

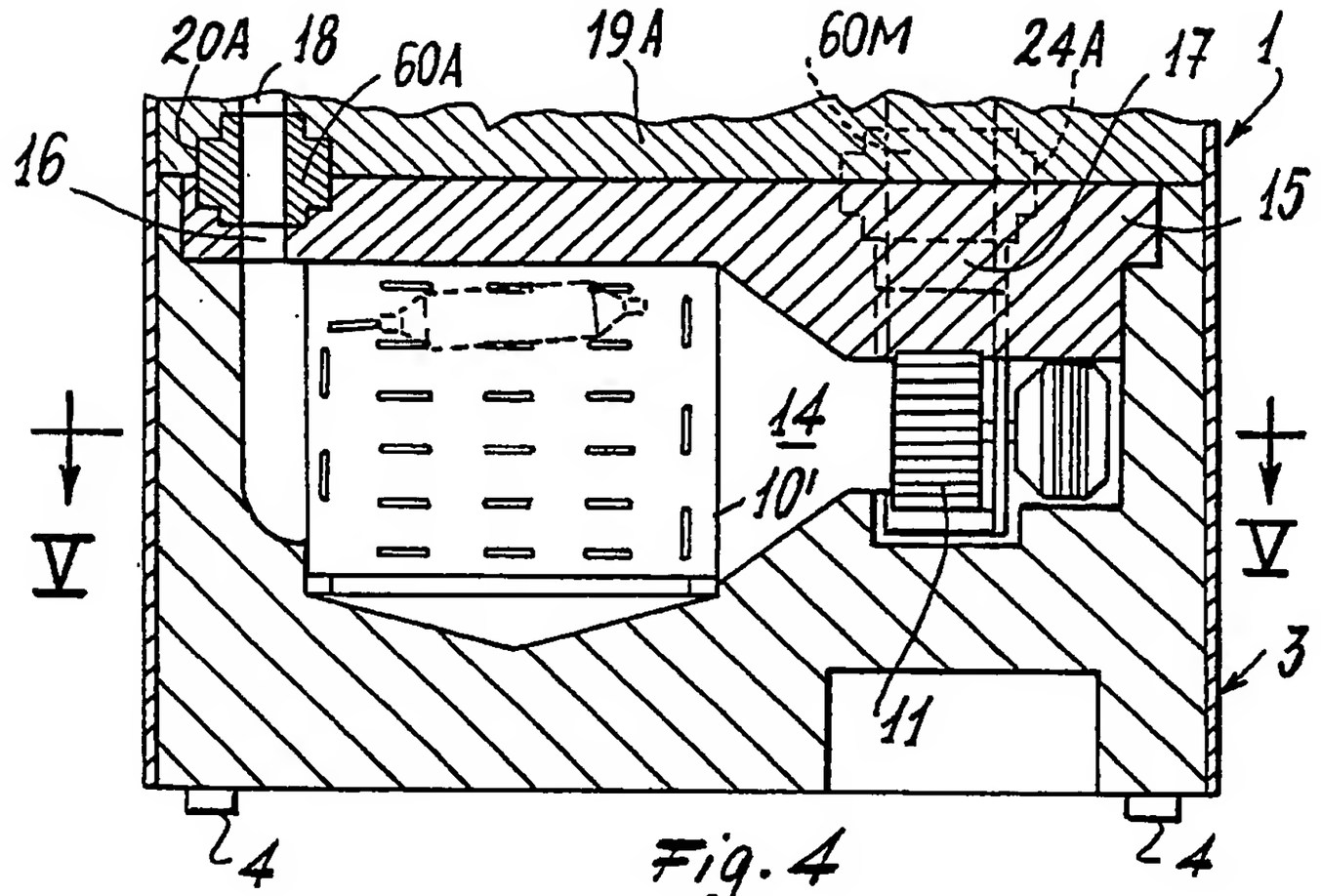
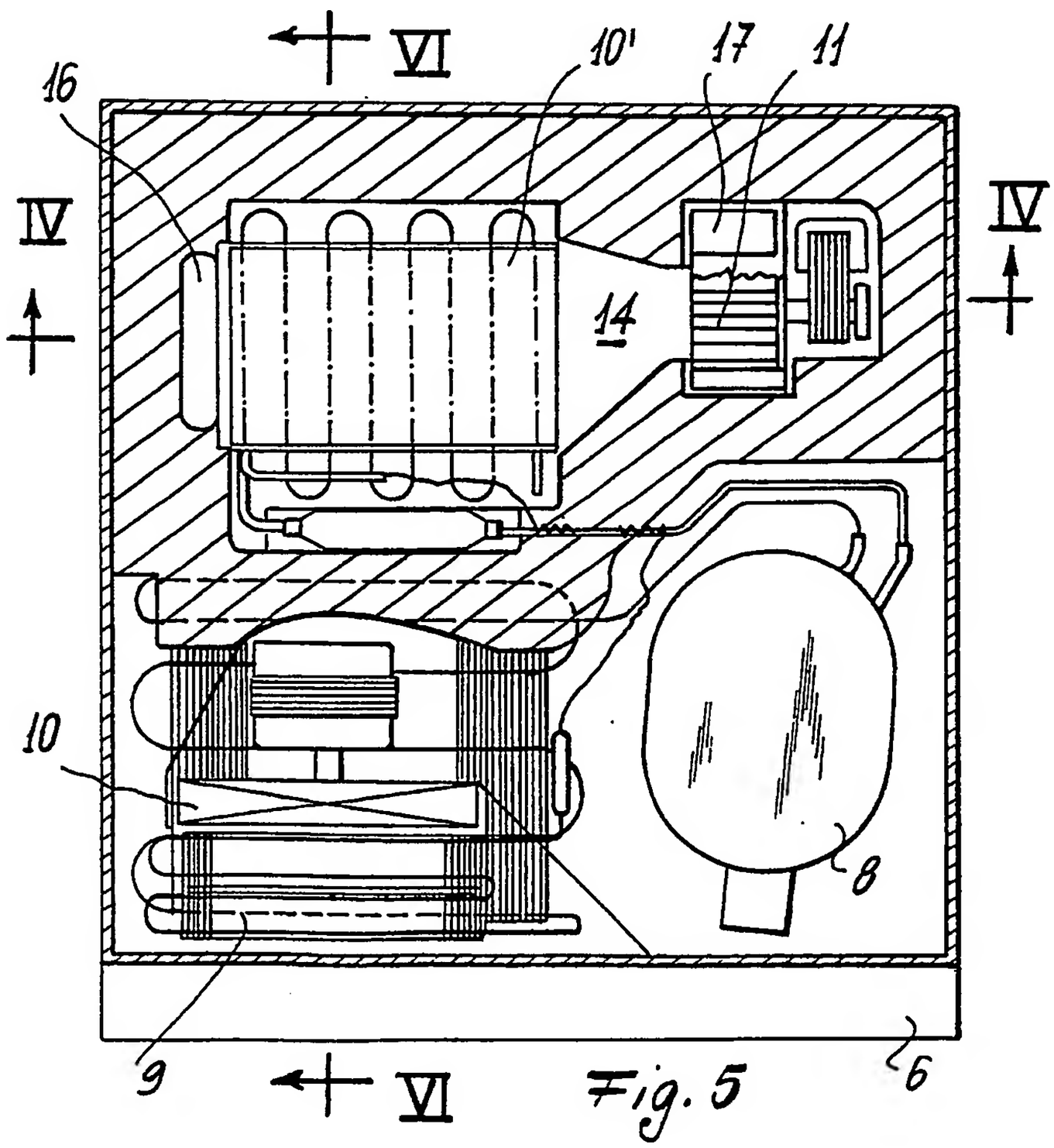

20A
18
60A
19A
60M
24A
17
1
16
15
14
10'
V
V
3
11
4
4

Fig. 4


VI
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17
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16
IV
IV
14
10
8
9
6
VI

Fig. 5

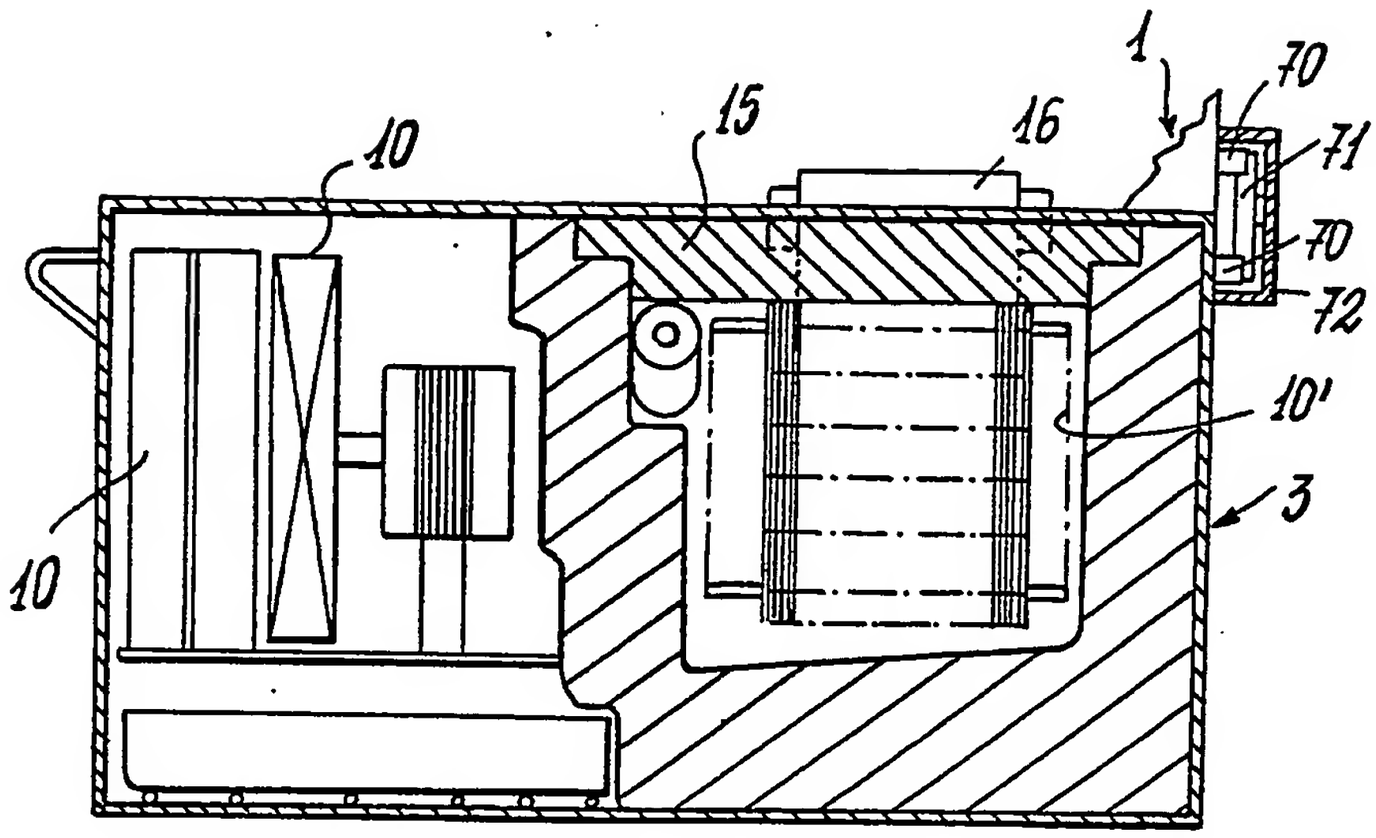

Fig. 6

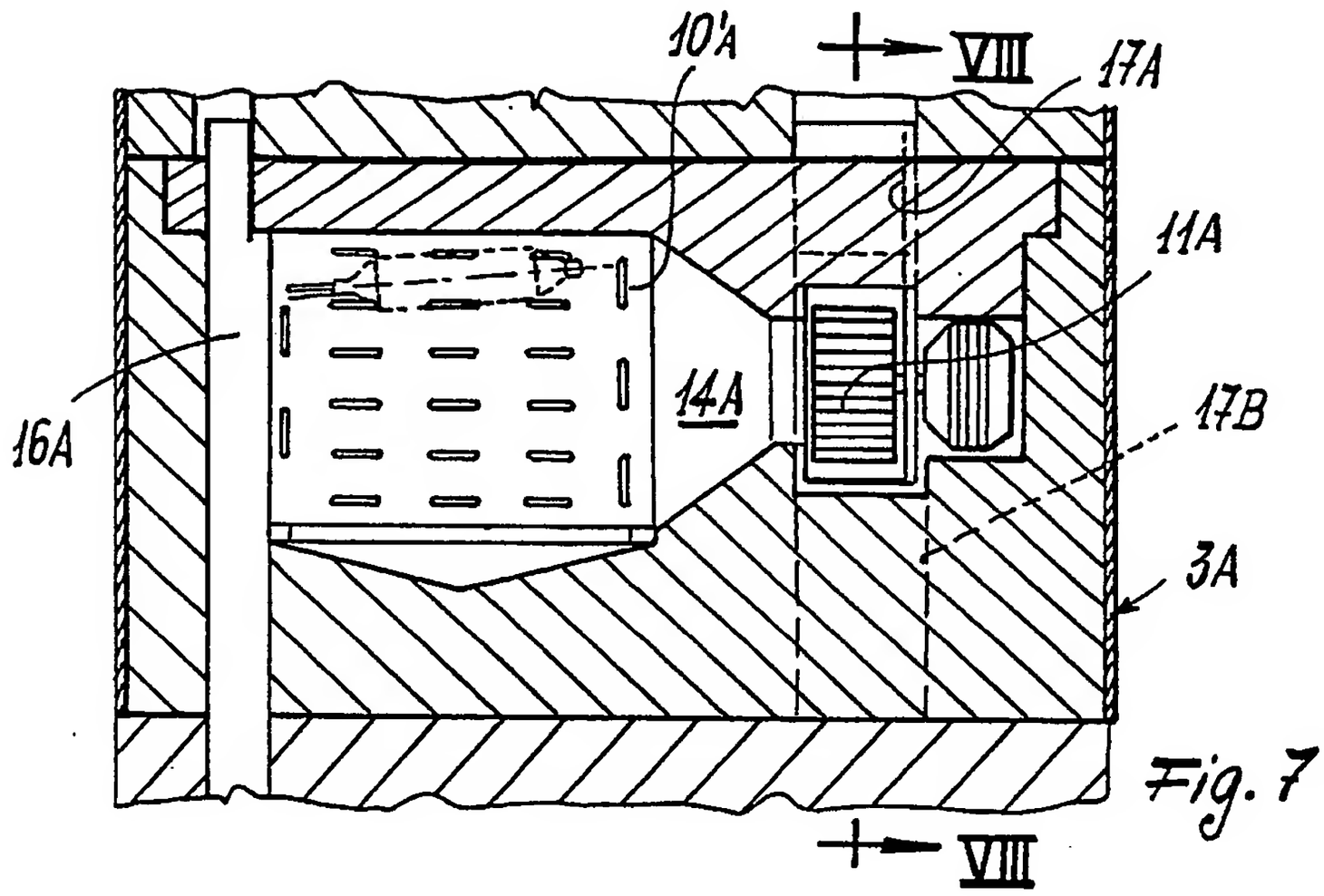

Fig. 7

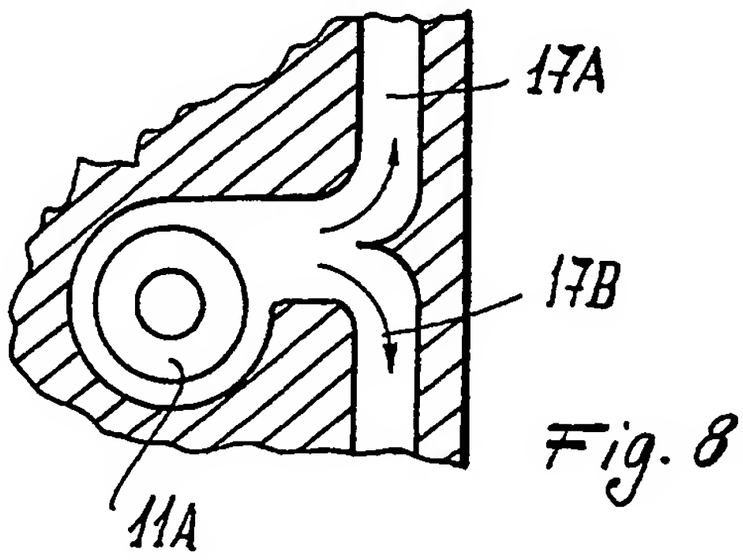

Fig. 8